POWERBOX Industrial Line
T30W Series
30W 4:1 Dual Output
DC/DC Converter
Manual

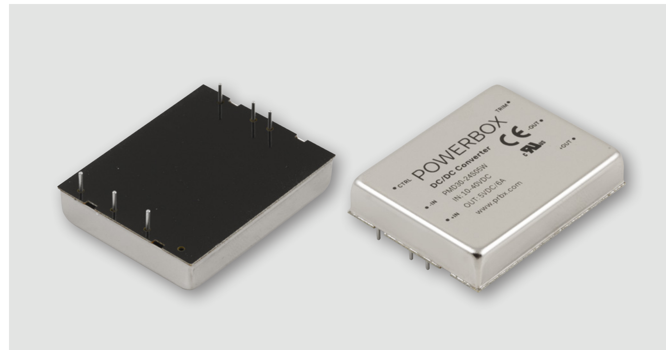


Table of Contents

Introduction

The T30W series offer 30 watts of output power from a 2.00 x 1.60 x 0.40 inch package. The T30W series with 2:1 wide input voltage of 9~18VDC, 18~36VDC and 36~75VDC and features 1600VDC of isolation, short-circuit and over-voltage protection.

DC/DC Converter Features

- 30 watts maximum output power
- Output current up to ±1.25A
- Standard 2.00 x 1.60 x 0.40 inch package
- High efficiency up to 86%
- 4:1 wide input voltage range
- Six-sided continuous shield
- Fixed switching frequency
- CE mark meets 2006/95/EC, 93/68/EEC and 2004/108/EC
- UL60950-1, EN60950-1 and IEC60950-1 licensed
- ISO9001 certified manufacturing facilities
- RoHS directive compliant

Options

- Negative logic remote on/off
- Heat-sink available for extended operation

Output Specifications

Parameters	Model	Min	Typ	Max	Unit
Output voltage range (Vin = Vin(nom) , full load , TA=25°C)	□□D12W	11.88	12	12.12	VDC
	□□D15W	14.85	15	15.15	VDC
Voltage adjustability	All	-10		+10	%
Line regulation (Vin(min) to Vin(max) at full load)	All	-0.5		+0.5	%
Load regulation (min. to 100% of full load)	All	-1.0		+1.0	%
Output ripple and noise					
Peak-to-peak (20MHz bandwidth)	□□D12W		100	125	mVp-p
(Measured with a 0.1µF/50V MLCC)	□□D15W		100	125	mVp-p
Temperature coefficient	All	-0.02		+0.02	%/°C
Output voltage overshoot (Vin(min) to Vin(max) full load; Ta=25°C)	All		0	5	% of Vout
Dynamic load response (Vin = Vin(nom) ; TA=25°C)					
Load step change from 75% to 100% or 100 to 75% of full load					
Peak Deviation	All		250		mV
Setting Time (Vout<10% peak deviation)	All		250		µs
Output current	□□D12W	0		±1250	mA
	□□D15W	0		±1000	mA
Output over voltage protection (zener diode clamp)	□□D12W		15		VDC
	□□D15W		18		VDC
Output over current protection	All			150	% of FL
Output short circuit protection	All	Hiccups, automatics recovery			

Input Specifications

Parameters	**Model**	**Min**	**Typ**	**Max**	**Unit**
Operating input voltage	24D□□W	10	24	40	VDC
	48D□□W	18	48	75	VDC
Input voltage					
Continuous	24D□□W			40	VDC
	48D□□W			75	VDC
Transient (100mS maximum)	24D□□W			50	VDC
	48D□□W			100	VDC
Input voltage variation (complies with EST300 132 part 4.49	All			5	V/ms
Input current					
(maximum value at Vin=Vin(nom), full load)	24D12W			1563	mA
	24D15W			1543	mA
	48D12W			772	mA
	48D15W			762	mA
Input standby current					
(typical value at Vin=Vin(nom), no load)	24D12W		30		mA
	24D15W		35		mA
	48D12W		25		mA
	48D15W		25		mA
Under voltage lockout turn-on threshold	24D□□W			10	VDC
	48D□□W			18	VDC
Under voltage lockout turn-off threshold	24D□□W		8		VDC
	48D□□W		16		VDC
Input reflected ripple current (5 to 20MHz, 12µH source impedance)	All		20		mAp-p
Start up time (Vin = Vin(nom) and constant resistive load)					
Power up	All		10	20	mS
Remote on/off	All		10	20	mS
Remote on/off control (the CTRL pin voltage is referenced to -INPUT)					
Positive logic					
DC-DC On (open)	All	3		12	VDC
DC-DC Off (short)	All	0		1.2	VDC
Negativ logic					
DC-DC On (open)	All	0		1.2	VDC
DC-DC Off (short)	All	3		12	VDC
Remote off state input current	All		3		mA
Input current of remote control pin	All	-0.5		0.5	mA

General Specifications

Parameters	Model	Min	Typ	Max	Unit
Efficiency					
(Vin = Vin(nom) , Full Load , TA=25°C)	24D12W		84		%
	24D15W		85		%
	48D12W		85		%
	48D15W		86		%
Isolation voltaga (1 minute)					
Input to output	All	1600			VDC
Input to case, output to case	All	1600			VDC
Isolation resistance	All	1			GΩ
Isolation capacitance	All			1000	pF
Switching frequency	All	270	300	330	kHz
Weight	All		48		g
MTBF MIL-HDBK-217F	All		7.598×10^5		hours
Over temperature protection	All		115		°C
Case material	All	Nickel-coated copper			
Base material	All	FR4 PCB			
Potting material	All	Epoxy (UL94 V-0)			
Dimensions	All	50.8 x 40.6 x 10.2 mm (2.00 x 1.60 x 0.40 inch)			

Environmental Specifications

Parameters	Model	Min	Typ	Max	Unit
Operating ambient temperature (with derating)*	All	-40		85	°C
Operating case temperature	All			100	°C
Storage temperature	All	-55		105	°C
Over temperature protection	All		115		°C
Thermal impedance					
Natural convection	All		10		°C/W
Natural convection with heat-sink	All		8.24		°C/W
Thermal shock	All	MIL-STD-810F			
Vibration	All	MIL-STD-810F			
Relative humidity	All	5		95	% RH

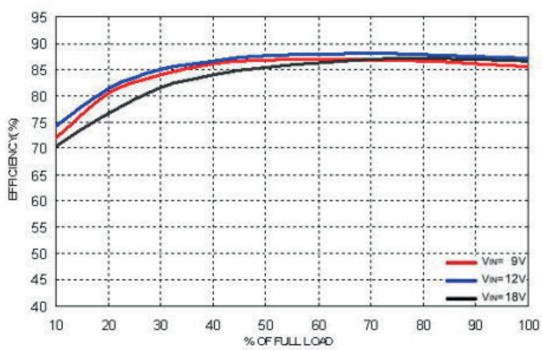
*Test condition with vertical direction by natural convection (20LFM)

EMC Characteristics

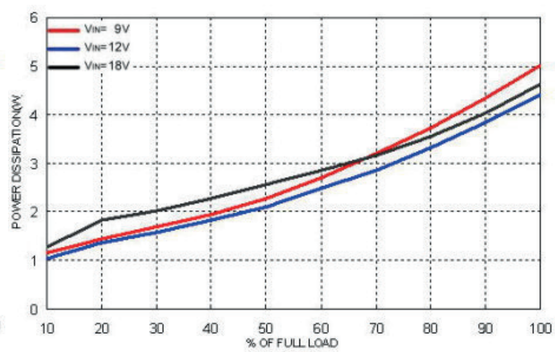
Parameters	Standard	Condition		Level
EMI	EN55022			Class A
ESD	EN61000-4-2	Air	±8kV	Perf. Criteria A
		Contact	±6kV	
Radiated Immunity	EN61000-4-3		10V/m	Perf. Criteria A
Fast transient*	EN61000-4-4		±2kV	Perf. Criteria A
Surge*	EN61000-4-5		±1kV	Perf. Criteria A
Conducted immunity	EN61000-4-6		10V r.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second		Perf. Criteria A

*An external input filter capacitor is required if the module has to meet EN61000-4-4, EN61000-4-5.
The filter capacitor Powerbox suggest: Nippon chemi-con KY series, 220μF/100V, ESR 48mΩ.

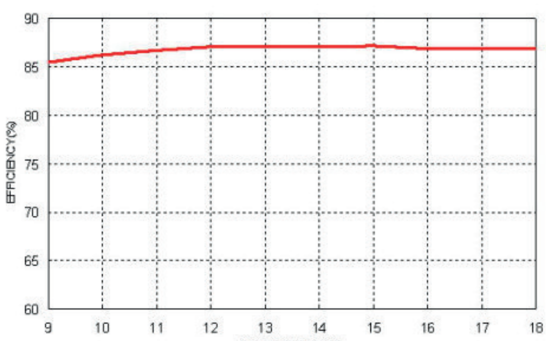
All test conditions are at 25°C.The figures are identical for PMD30-24D12W



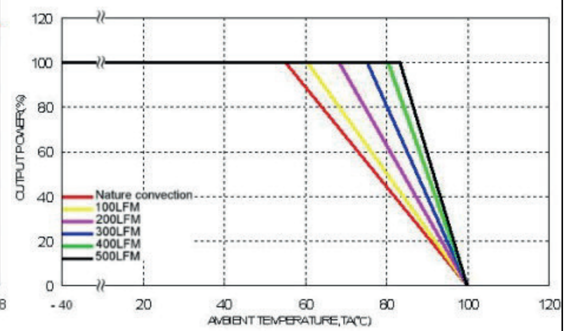
Efficiency Versus Output Current



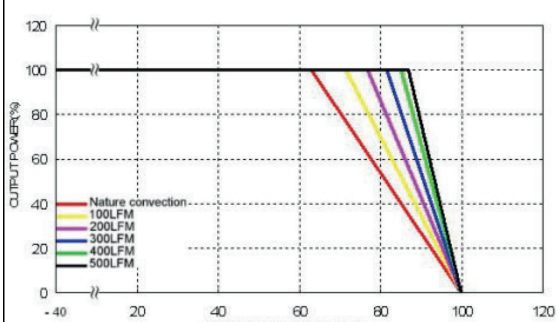
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

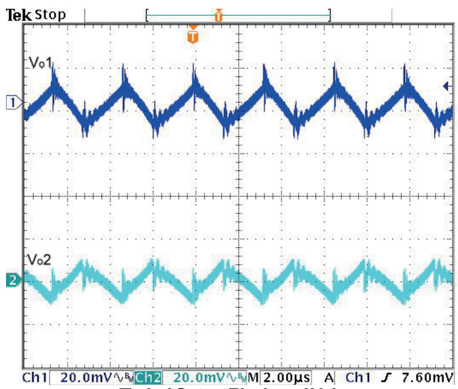


Derating Output Current Versus Ambient Temperature and Airflow
Vin=Vin(nom)

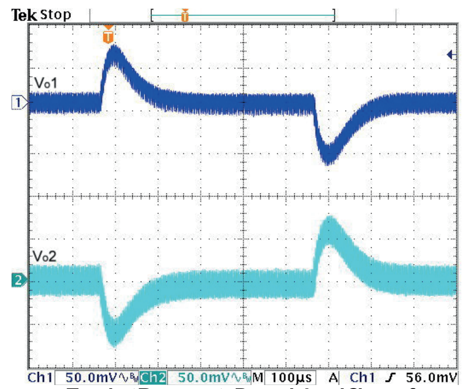


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow,
Vin=Vin(nom)

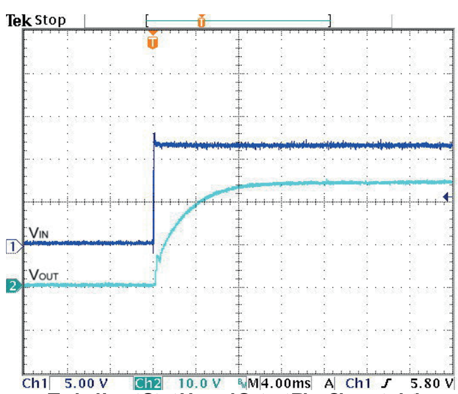
All test conditions are at 25°C.The figures are identical for PMD30-24D12W



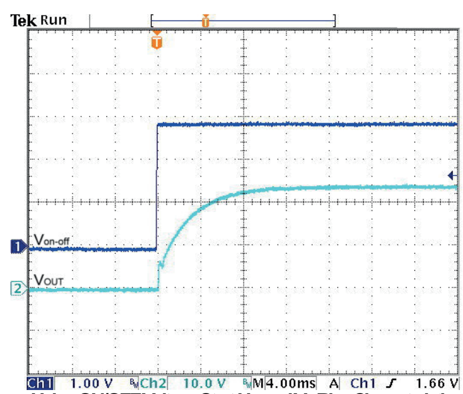
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



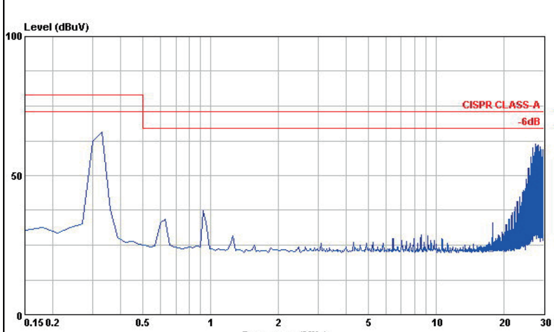
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



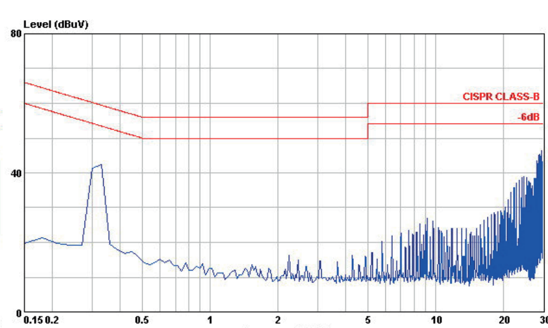
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load

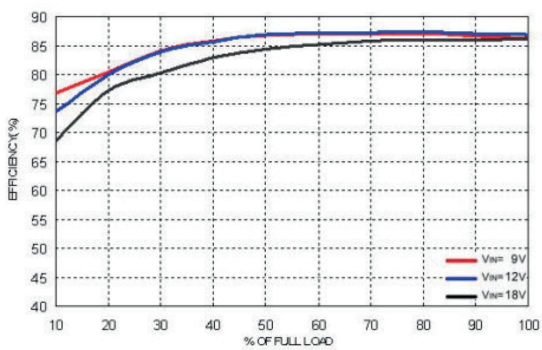


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

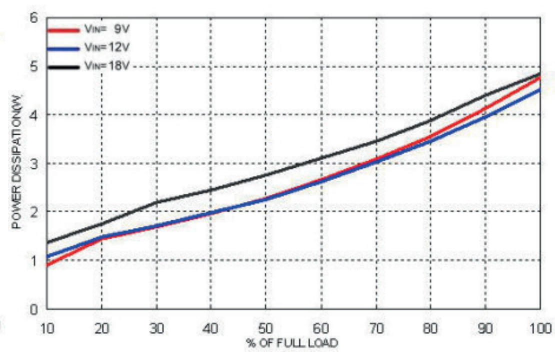


Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

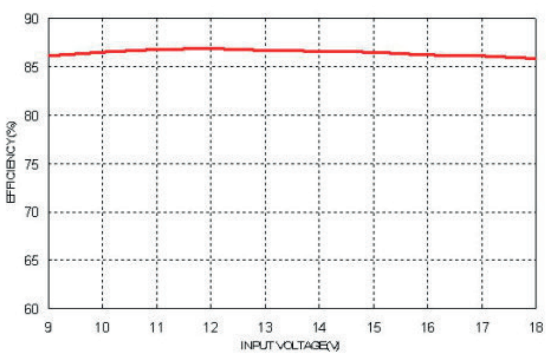
All test conditions are at 25°C.The figures are identical for PMD30-24D15W



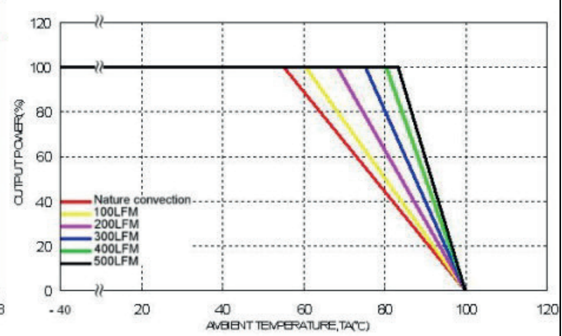
Efficiency Versus Output Current



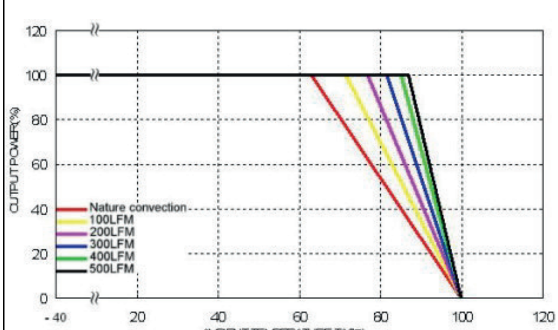
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

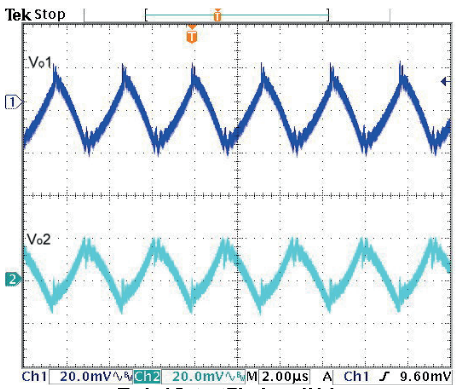


Derating Output Current Versus Ambient Temperature and Airflow Vin=Vin(nom)

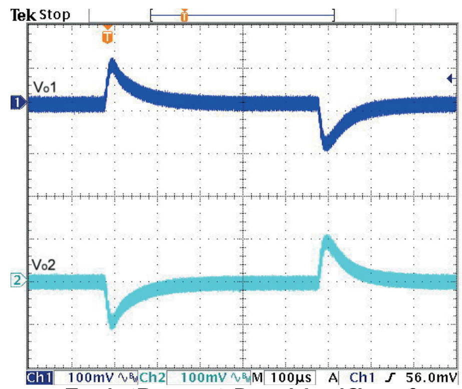


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow, Vin=Vin(nom)

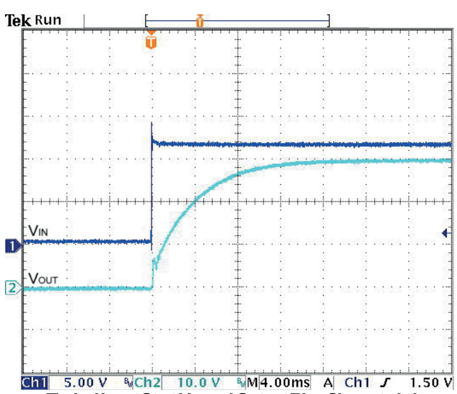
All test conditions are at 25°C.The figures are identical for PMD30-24D15W



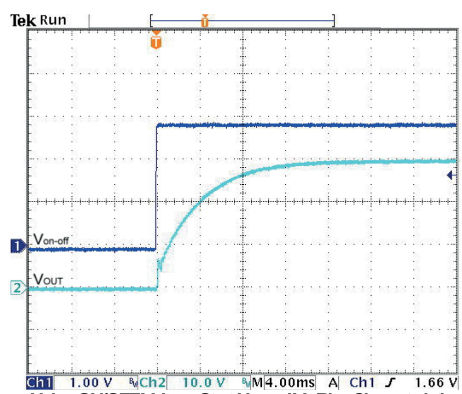
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



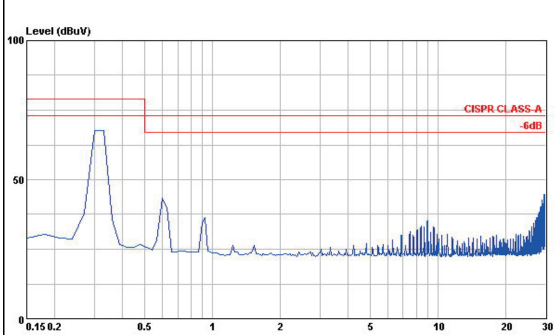
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



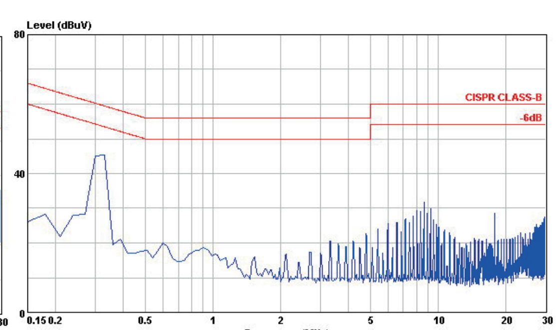
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load

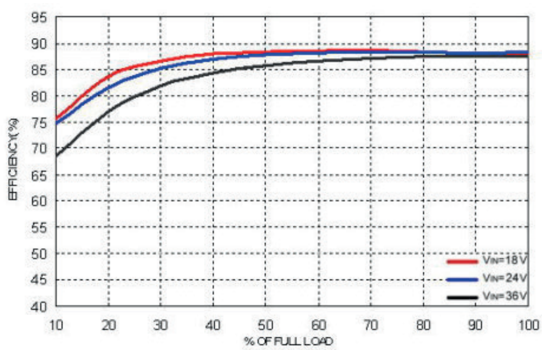


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

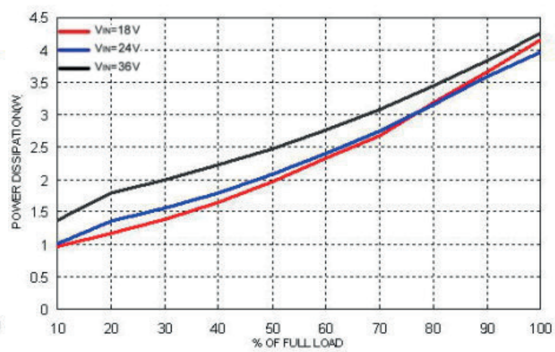


Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

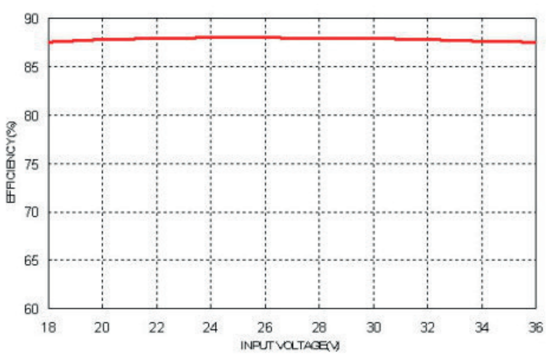
All test conditions are at 25°C.The figures are identical for PMD30-24D12W



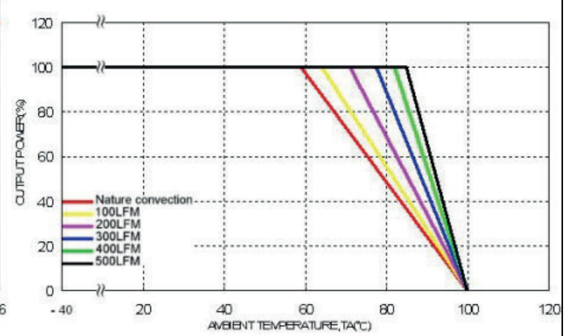
Efficiency Versus Output Current



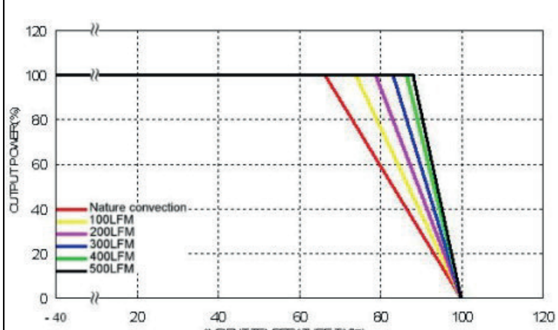
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

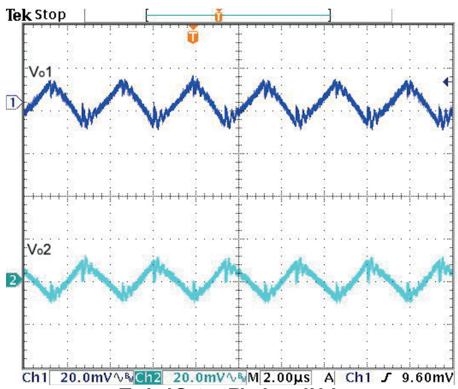


Derating Output Current Versus Ambient Temperature and Airflow
Vin=Vin(nom)

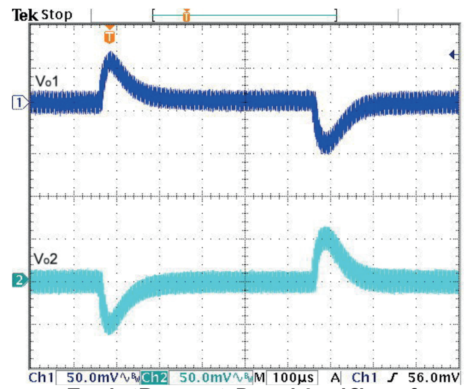


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow,
Vin=Vin(nom)

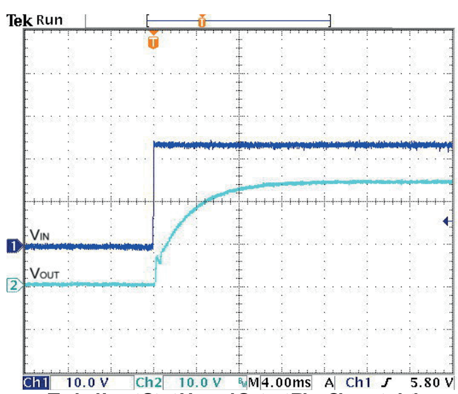
All test conditions are at 25°C.The figures are identical for PMD30-24D12W



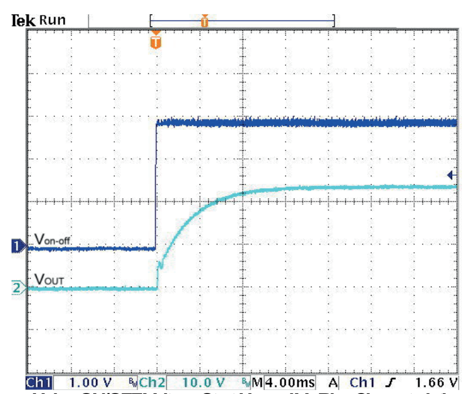
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



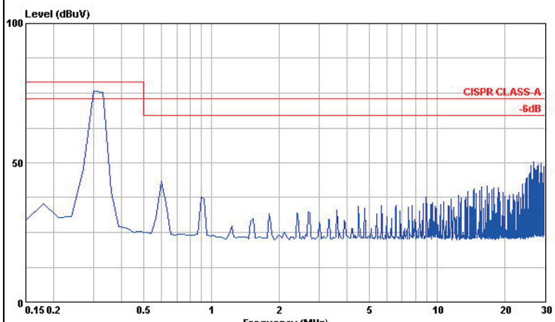
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



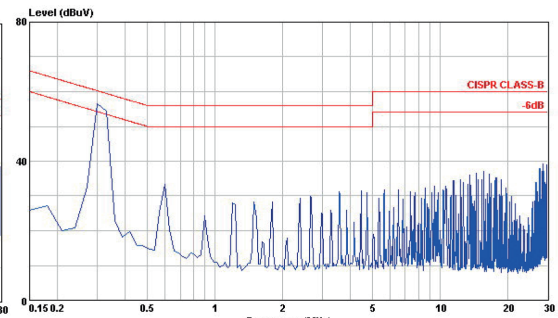
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load

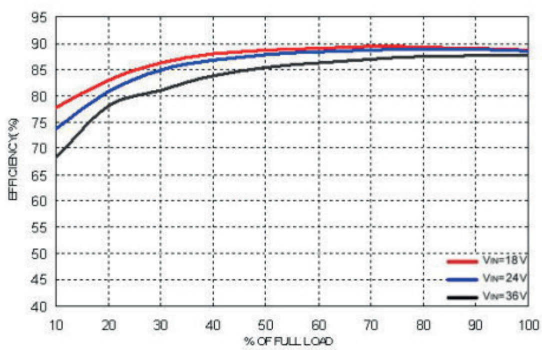


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

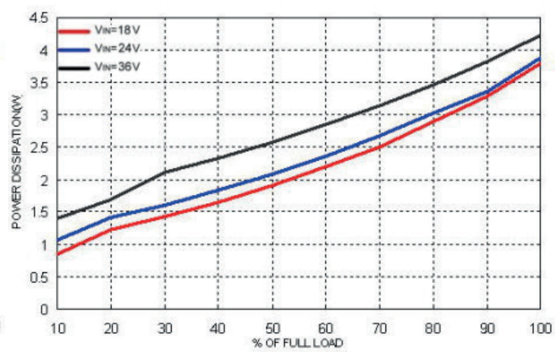


Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

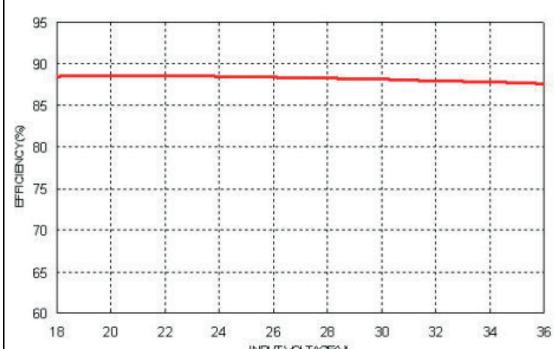
All test conditions are at 25°C.The figures are identical for PMD30-24D15W



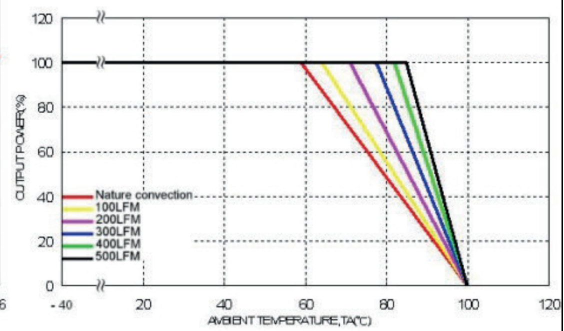
Efficiency Versus Output Current



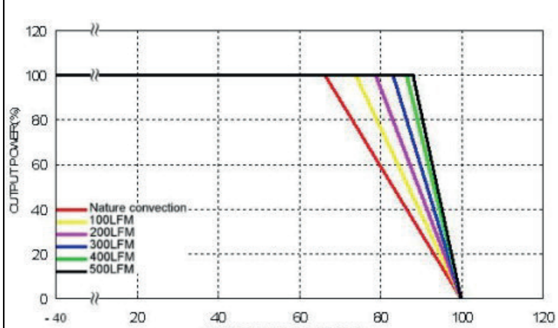
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

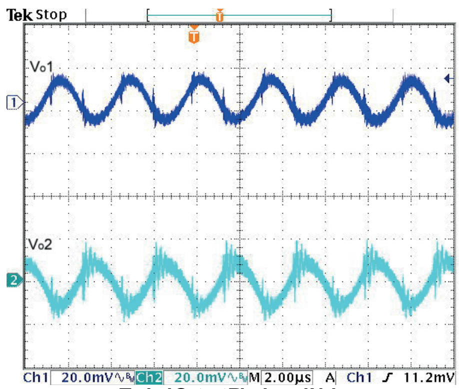


Derating Output Current Versus Ambient Temperature and Airflow
Vin=Vin(nom)

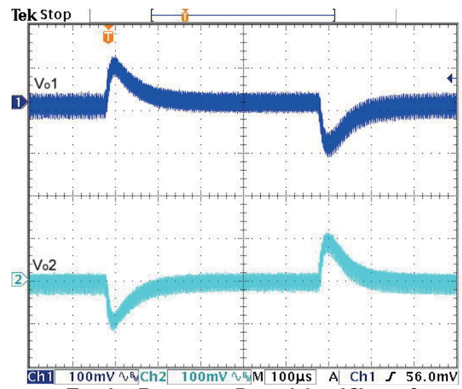


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow,
Vin=Vin(nom)

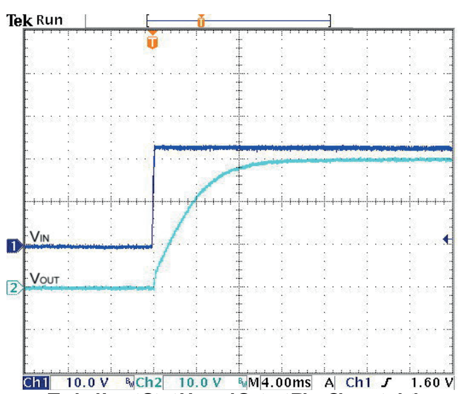
All test conditions are at 25°C.The figures are identical for PMD30-24D15W



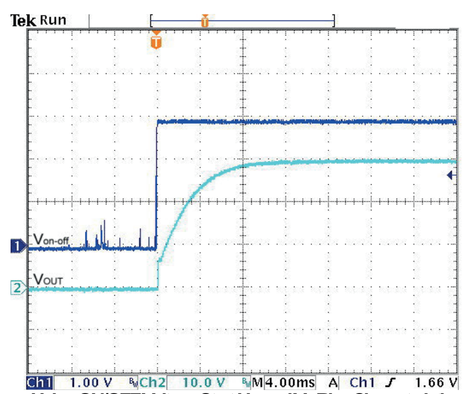
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



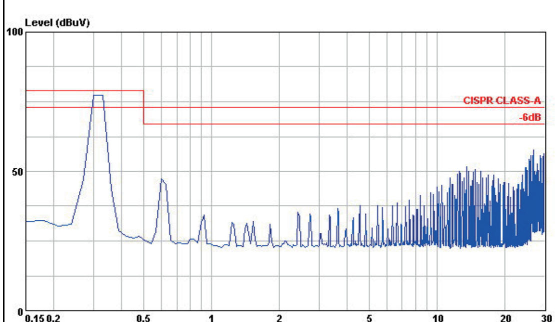
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



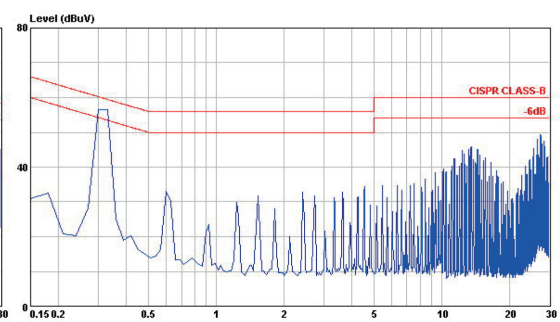
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load

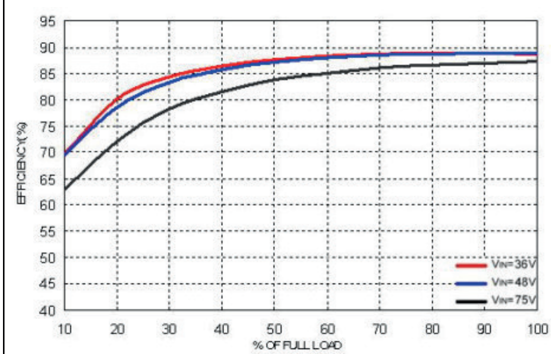


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

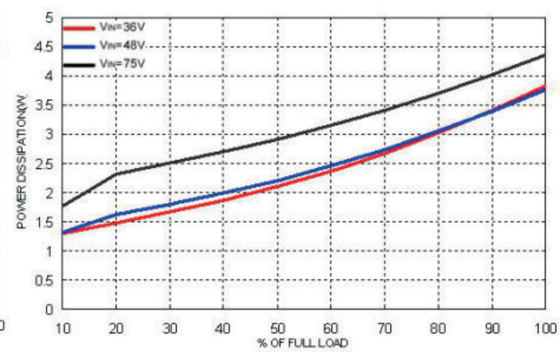


Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

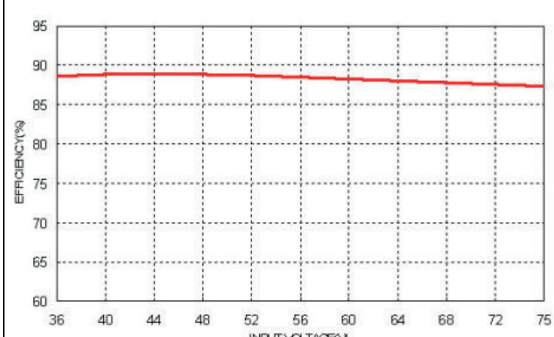
All test conditions are at 25°C.The figures are identical for PMD30-48D12W



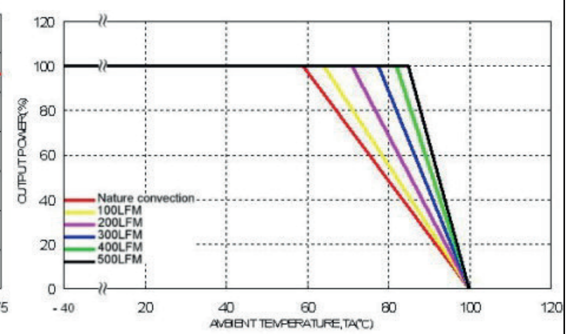
Efficiency Versus Output Current



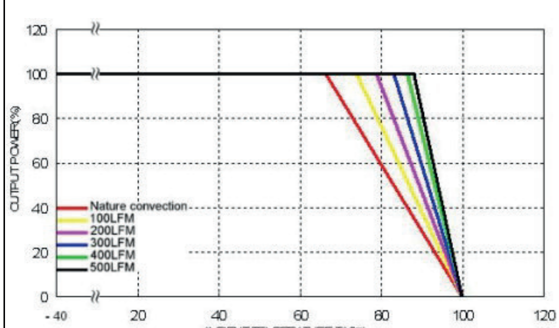
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

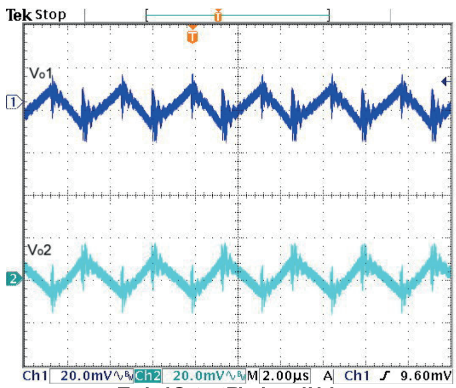


Derating Output Current Versus Ambient Temperature and Airflow
Vin=Vin(nom)

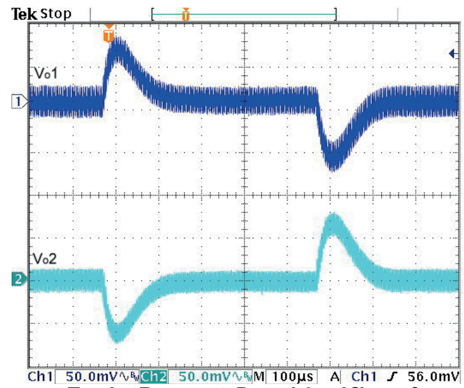


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow,
Vin=Vin(nom)

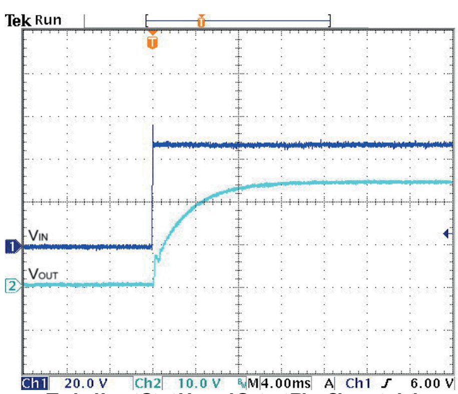
All test conditions are at 25°C.The figures are identical for PMD30-48D12W



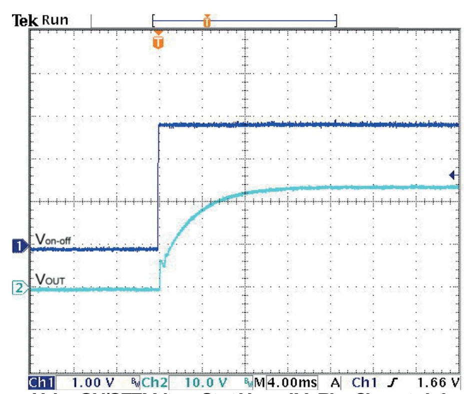
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



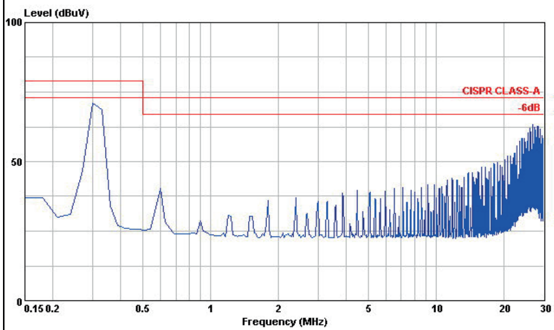
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



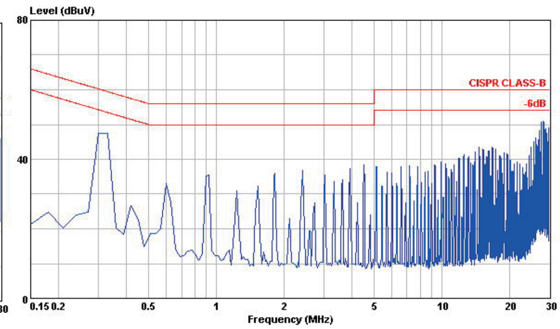
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load

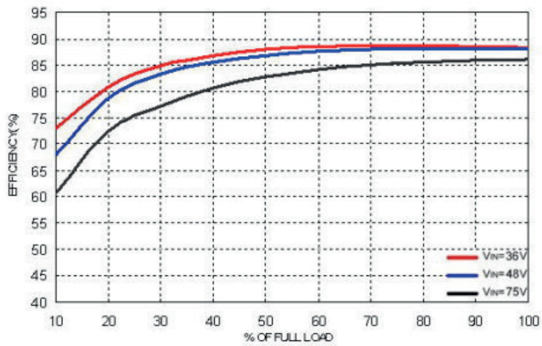


Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load

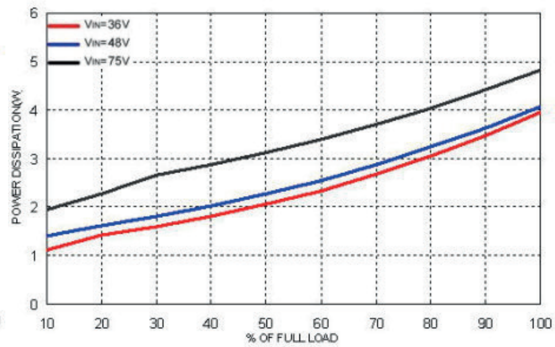


Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

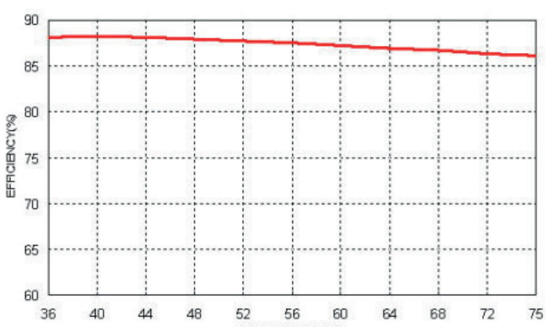
All test conditions are at 25°C.The figures are identical for PMD30-48D15W



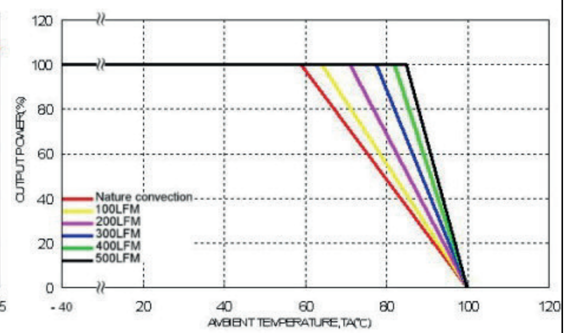
Efficiency Versus Output Current



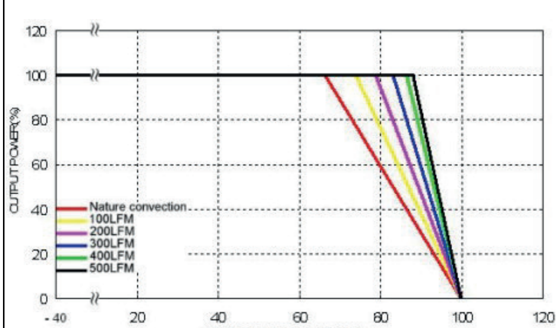
Power Dissipation Versus Output Current



Efficiency Versus Input Voltage. Full Load

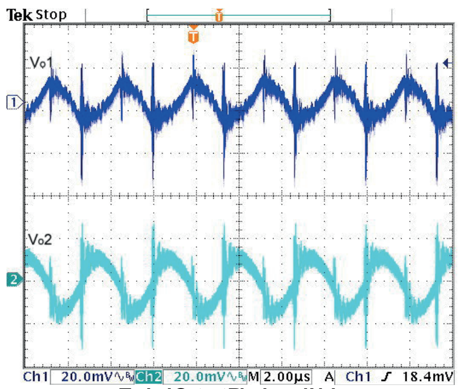


Derating Output Current Versus Ambient Temperature and Airflow
Vin=Vin(nom)

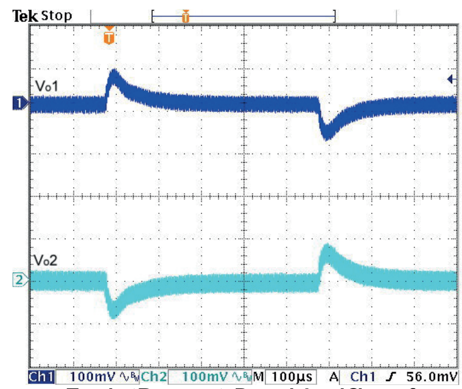


Derating Output Current Versus Ambient Temperature with Heatsink and Airflow,
Vin=Vin(nom)

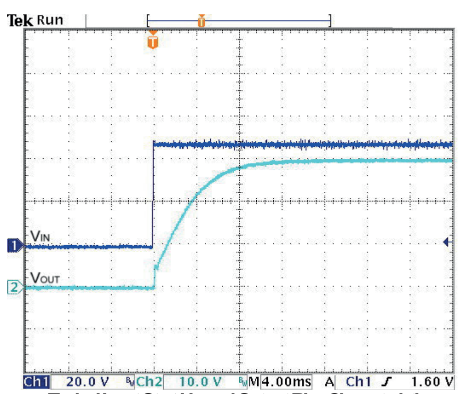
All test conditions are at 25°C.The figures are identical for PMD30-48D15W



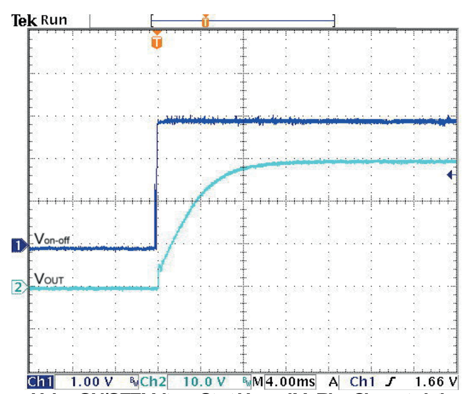
Typical Output Ripple and Noise.
Vin=Vin(nom), Full Load



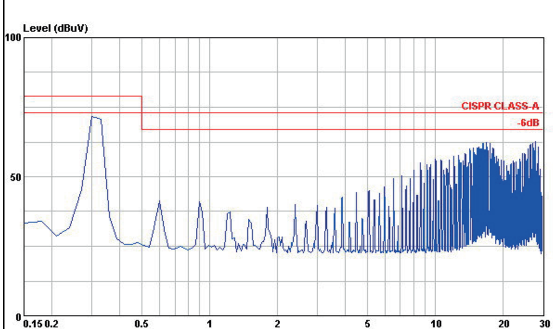
Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load, Vin=Vin(nom)



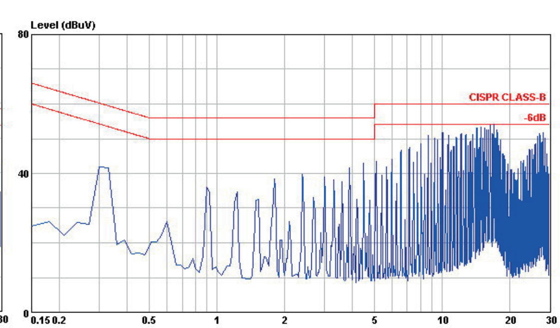
Typical Input Start-Up and Output Rise Characteristic
Vin=Vin(nom), Full Load



Using ON/OFF Voltage Start-Up and Vo Rise Characteristic
Vin=Vin(nom), Full Load



Conduction Emission of EN55022 Class A
Vin=Vin(nom), Full Load



Conduction Emission of EN55022 Class B
Vin=Vin(nom), Full Load

Input Source Impedance

The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12μH and capacitor is Nippon chemi-con KY series 220μF/100V. The capacitor must as close as possible to the input terminals of the power module for lower impedance.

Output Over Current Protection

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload current is maintained at approximately 130 percent of rated current for T30W-D SERIES.

Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over-current fault condition. It also enables the power supply to restart when the fault is removed. There are other ways of protecting the power supply when it is over-loaded, such as the maximum current limiting or current foldback methods.

One of the problemS resulting from over current is that excessive heat may be generated in power devices, especially MOSFET and Schottky diodes and the temperature of those devices may exceed their specified limits. A protection mechanism has to be used to prevent those power devices from being damaged.

The operation of hiccup is as follows. When the current sense circuit sees an over-current event, the controller shuts off the power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will start up and operate normally, otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Hiccup operation has none of the drawbacks of the other two protection methods, although its circuit is more complicated because it requires a timing circuit. The excess heat due to overload lasts for only a short duration in the hiccup cycle, hence the junction temperature of the power devices is much lower.

The hiccup operation can be done in various ways. For example, one can start hiccup operation any time an over-current event is detected, or prohibit hiccup during a designated start-up is usually larger than during normal operation and it is easier for an over-current event is detected, or prohibit hiccup during a designated start-up interval (usually a few milliseconds). The reason for the latter operation is that during start-up, the power supply needs to provide extra current to charge up the output capacitor. Thus the current demand during start-up is usually larger than during normal operation and it is easier for an over-current event to occur. If the power supply starts to hiccup once there is an over-current, it might never start up successfully. Hiccup mode protection will give the best protection for a power supply against over current situations, since it will limit the average current to the load at a low level, so reducing power dissipation and case temperature in the power devices.

Output Over Voltage Protection

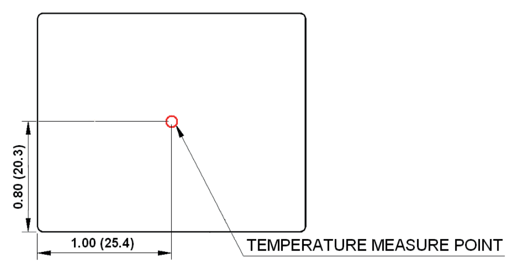
The output over-voltage protection consists of output Zener diode that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode clamps the output voltage.

Short Circuitry Protection

Continuous, hiccup and auto-recovery mode. During short circuit, converter still shut down. The average current during this condition will be very low and the device can be safety in this condition.

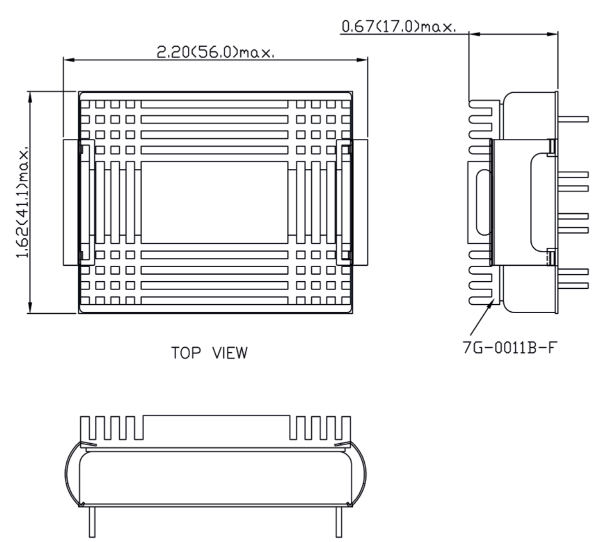
Thermal Consideration

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the point as the figure below. The temperature at this location should not exceed 100°C. When operating, adequate cooling must be provided to maintain the test point temperature at or below 100°C. Although the maximum point temperature of the power modules is 100°C, you can limit this Temperature to a lower value for extremely high reliability.



Heat-Sink Considerations

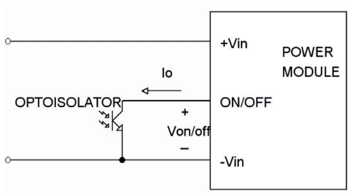
Equip Heat-sink (7G-0011C-F) for lower temperature and higher reliability of the module. Considering space and air-flow is the way to choose which Heat-sink is needed.



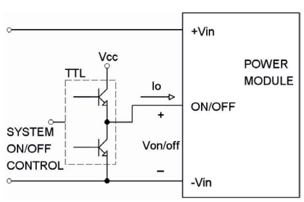
Remote On/Off Control

The Remote CTRL pin is controlled DC/DC power module to turn on and off, the user must use a switch to control the logic voltage high or low level of the pin referenced to -INPUT. The switch can be open collector transistor, FET and Photo-Couple. The switch must be capable of sinking up to 0.5 mA at low-level logic voltage. High-level logic of the CTRL pin signal maximum voltage is allowable leakage current of the switch at 12V is 0.5mA.

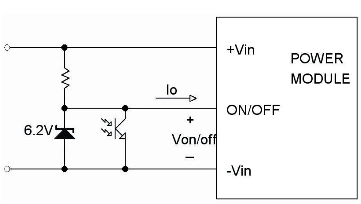
Remote ON/OFF Implementation Circuits



Isolated-Closure Remot ON/OFF



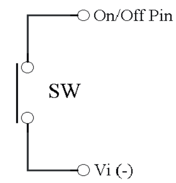
Level Control Using TTL Output



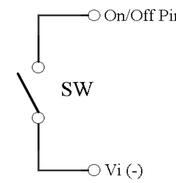
Level Control Using Line Voltage

There are two remote control options available, positive logic and negative logic.

a. The Positive logic structure turned on of the DC/DC module when the CTRL pin is at high-level logic and low-level logic is turned off it.

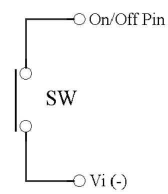


When T30W module is turned off at Low-level logic

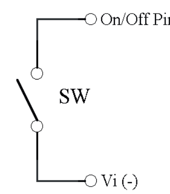


When T30W module is turned on at High-level logic

b. The Negative logic structure turned on of the DC/DC module when the CTRL pin is at low-level logic and turned off when at high-level logic.

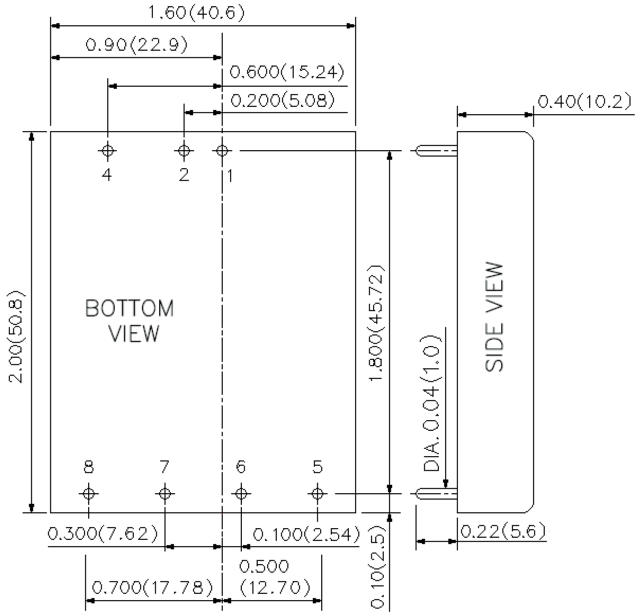


When T30W module is turned on at Low-level logic



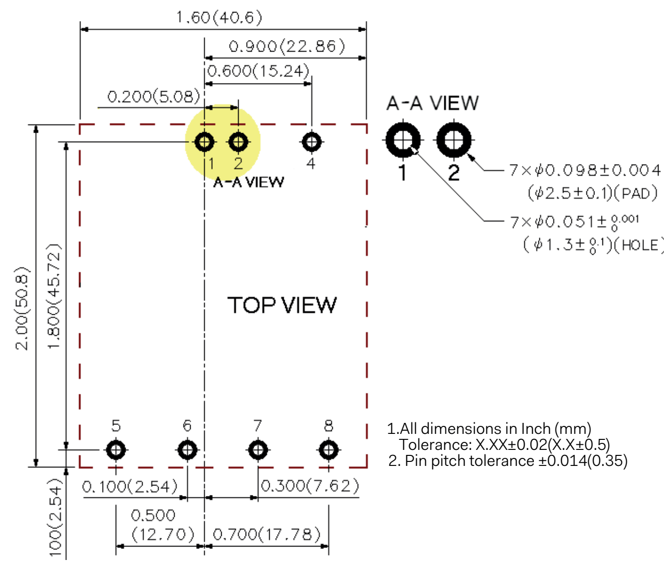
When T30W module is turned off at High-level logic

Mechanical Data



1. All dimensions in Inch (mm)
   Tolerance: X.XX±0.02 (X.X±0.5)
   X.XXX±0.01 (X.XX±0.25)
2. Pin pitch tolerance ±0.01(0.25)
3. Pin dimension tolerance ±0.004 (0.1)

Recommended Pad Layout

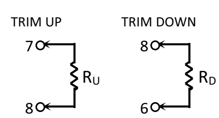


Pin Connection

Pin	Define
1	+INPUT
2	-INPUT
4	CTRL
5	NO PIN
6	+OUTPUT
7	-OUTPUT
8	TRIM

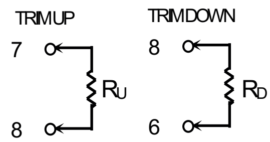
External Output Trimming

Output can be externally trimmed by using the method shown below.



Output Voltage Adjustment

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the +OUTPUT or -OUTPUT pins. With an external resistor between the TRIM and -OUTPUT pin, the output voltage set point increases. With an external resistor between the TRIM and +OUTPUT pin, the output voltage set point decreases. The external TRIM resistor needs to be at least 1/16W resistors.



Trim Table

PMD30-□□D12W	**Trim-Up**									
Trim-Up (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
VOUT (Volts)=	±12.12	±12.24	±12.36	±12.48	±12.6	±12.72	±12.84	±12.96	±13.08	±13.2
RU (K OhmS)=	218.21	98.105	58.07	38.052	26.042	18.035	12.316	8.026	4.69	2.021

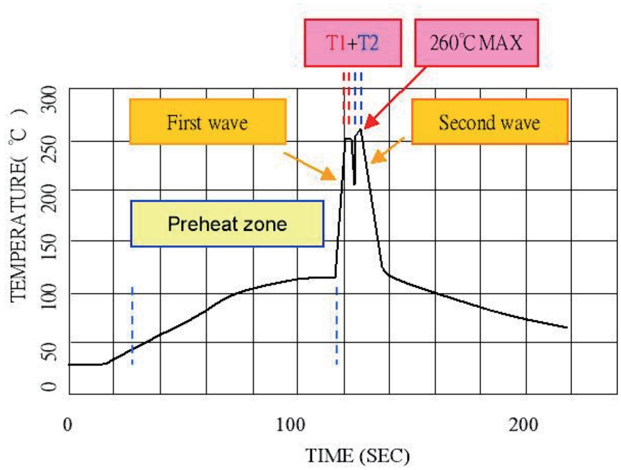
PMD30-□□D12W	**Trim-Down**									
Trim-Down (%)	1	2	3	4	5	6	7	8	9	10
VOUT (Volts)=	±11.88	±11.76	±11.64	±11.52	±11.4	±11.28	±11.16	±11.04	±10.92	±10.8
RD (K OhmS)=	273.44	123.02	72.874	47.803	32.76	22.732	15.568	10.196	6.017	2.675

PMD30-□□D15W	**Trim-Up**									
Trim-Up (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
VOUT (Volts)=	±15.15	±15.3	±15.45	±15.6	±15.75	±15.9	±16.05	±16.2	±16.35	±16.5
RU (K OhmS)=	268.29	120.64	71.429	46.822	32.058	22.215	15.184	9.911	5.81	2.529

PMD30-□□D15W	**Trim-Down**									
Trim-Down (%)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
VOUT (Volts)=	±14.85	±14.7	±14.55	±14.4	±14.25	±14.1	±13.95	±13.8	±13.65	±13.5
RD (K OhmS)=	337.71	152.02	90.126	59.178	40.609	28.23	19.387	12.756	7.598	3.471

Soldering Considerations

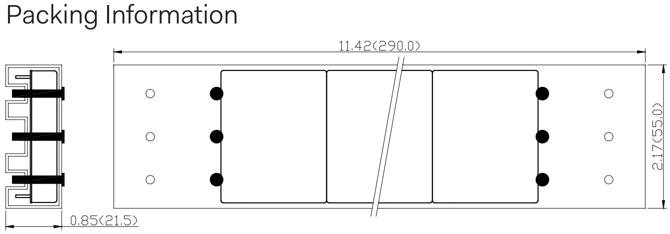
Lead free wave solder profile for DIP type.



Zone	Reference Parameter
Preheat zone	Rise temp. speed : 3°C/ sec max. Preheat temp. : 100~130°C
Actual heating	Peak temp. : 250~260°C Peak time (T1+T2 time) : 4~6 sec

Reference Solder: Sn-Ag-Cu , Sn-Cu
Hand Welding: Soldering iron: Power 90W
Welding Time: 2~4 sec
Temp.: 380~400°C

Packing Information



All dimensions in inch(mm)
5 pcs per tube.

Safety and Installation Instruction

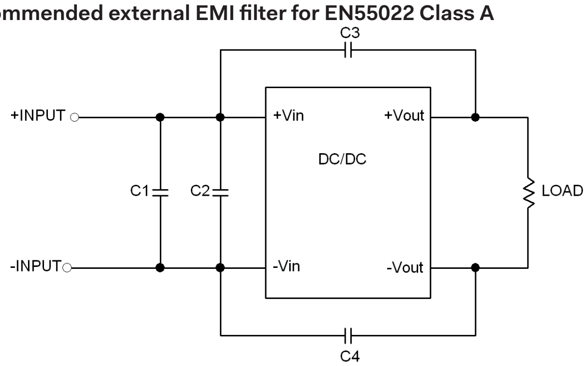
Fusing Consideration

Caution: This power module is not internally fused. An input line fuse must always be used. This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included, however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a slow-blow fuse with maximum rating of 6A. Based on the information provided in this data sheet on Inrush energy and maximum DC input current, the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

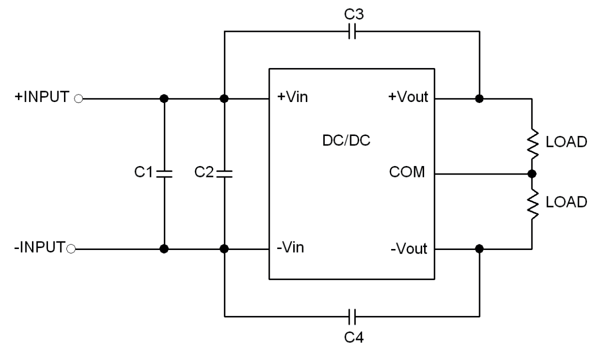
MTBF and Reliability

The MTBF of T30 DUAL-SERIES of DC/DC converters has been calculated using MIL-HDBK 217F @Ta=25°C, FULL LOAD. The resulting figure for MTBF is $7.598x10^5$ hours.

Recommended external EMI filter for EN55022 Class A



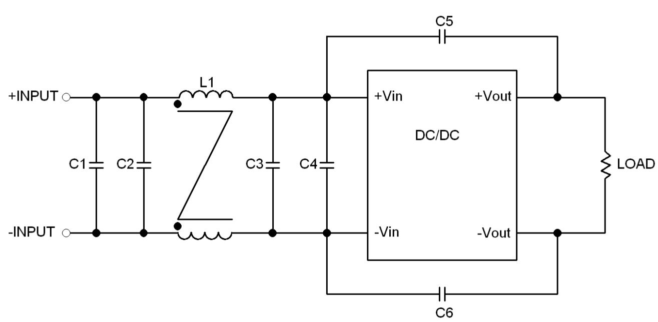
Single Output



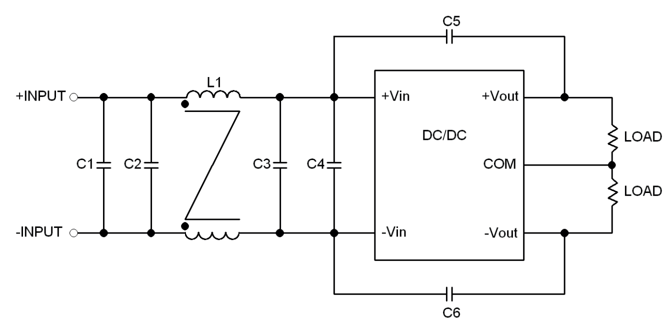
Dual Output

Model	C1	C2	C3	C4
PMD30-24□□□W	6.8μF/50V 1812 MLCC	N/A	1000pF/2kV 1808 MLCC	1000pF/2kV 1808 MLCC
PMD30-48□□□W	2.2μF/100V 1812 MLCC	2.2μF/100V 1812 MLCC	1000pF/2kV 1808 MLCC	1000pF/2kV 1808 MLCC

Recommended external EMI filter for EN55022 Class B



Single Output



Dual Output

Model	C1	C2	C3	C4	C5, C6	L1
PMD30-24□□□W	6.8μF/50V 1812 MLCC	N/A	6.8μF/50V 1812 MLCC	N/A	1000pF/2kV 1808 MLCC	450μH Common Shoke PMT-048
PMD30-48□□□W	2.2μF/100V 1812 MLCC	2.2μF/100V 1812 MLCC	2.2μF/50V 1812 MLCC	2.2μF/50V 1812 MLCC	1000pF/2kV 1808 MLCC	450μH Common Shoke PMT-048